

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark  
Office  
(Box PCT)  
Crystal Plaza 2  
Washington, DC 20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 07 January 1998 (07.01.98)	
<b>International application No.</b> PCT/GB97/01176	<b>Applicant's or agent's file reference</b> BKCD/SMR/TBS.39
<b>International filing date</b> (day/month/year) 01 May 1997 (01.05.97)	<b>Priority date</b> (day/month/year) 17 May 1996 (17.05.96)
<b>Applicant</b> BARGE, Christopher, Stephen et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

12 December 1997 (12.12.97)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer Jocelyne Rey-Millet</p> <p>Telephone No.: (41-22) 338.83.38</p>
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# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>BKCD/SMR/TBS. 39</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 97/ 01176</b>	International filing date (day/month/year) <b>01/05/1997</b>	(Earliest) Priority Date (day/month/year) <b>17/05/1996</b>
Applicant <b>TBS ENGINEERING LIMITED et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).

2. ☐ Unity of invention is lacking (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.

☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority

4. With regard to the **title**, ☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**Frame and loading apparatus for groups of battery plates**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

Figure No. 5 ☐ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 97/01176 ✓

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01M10/14 B65H31/06 H01M10/12 H01M10/04 H01M2/28  
H01M2/26 B65H31/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 27897 A (TBS ENG LTD ;HOPWOOD ROBERT TIMOTHY (GB)) 8 December 1994	1
Y	see page 3, line 1-28 see page 7, line 6-26 see figures 2,6,9	2-11
Y	GB 2 251 975 A (DAGA S R L) 22 July 1992 see figure 2 see page 3, line 4-17 see page 4, line 6-29 see page 6, line 17-30	1-11
Y	US 4 074 422 A (BORJESSON ANDERS ET AL) 21 February 1978 see column 2, line 17-54 see column 3, line 52 - column 4, line 9 see claims 1,7,8 see figures 1-7	1-11
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*&\* document member of the same patent family

Date of the actual completion of the international search

24 July 1997

Date of mailing of the international search report

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,  
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Authorized officer

Engl, H

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB 97/01176

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 013 964 A (CHLORIDE GROUP LTD) 15 August 1979 see the whole document ---	1-15
A	US 3 444 920 A (MCALPINE CHARLES H ET AL) 20 May 1969 see column 9, line 21-46 ---	1-15
A	US 4 887 350 A (HOPWOOD ROBERT T) 19 December 1989 see column 1, line 45-67 see column 3, line 1-40 -----	1-15

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 97/01176

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9427897 A	08-12-94	AU 670690 B	25-07-96
		AU 6656194 A	20-12-94
		CA 2138035 A	30-11-94
		EP 0651722 A	10-05-95
		JP 8500207 T	09-01-96
		US 5459922 A	24-10-95
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GB 2251975 A	22-07-92	IT 1246953 B	01-12-94
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US 4074422 A	21-02-78	SE 420550 B	12-10-81
		DE 2655002 A	23-06-77
		GB 1503866 A	15-03-78
		SE 7513827 A	10-06-77
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GB 2013964 A	15-08-79	NONE	
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US 3444920 A	20-05-69	DE 1596183 A	29-04-71
		FR 1502304 A	02-02-68
		GB 1126818 A	
		US 3515204 A	02-06-70
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US 4887350 A	19-12-89	AU 598907 B	05-07-90
		AU 1153288 A	10-08-88
		AU 5000790 A	14-06-90
		DE 3886385 D	27-01-94
		DE 3886385 T	26-05-94
		EP 0341255 A	15-11-89
		WO 8805608 A	28-07-88
		JP 2502141 T	12-07-90
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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SCE/GH/TBS.39	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (PCT/IPEA/416)
International application No. PCT/GB97/01176	International filing date (day/month/year) 01/05/1997	Priority date (day/month/year) 17/05/1996	
International Patent Classification (IPC) or national classification and IPC H01M10/14			
Applicant TBS ENGINEERING LIMITED et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 6 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 12/12/1997	Date of completion of this report <b>21. 07. 98</b>
Name and mailing address of the IPEA/   European Patent Office D-80298 Munich Tel. (+49-89) 2399-0, Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer  Engl, H  Telephone No. (+49-89) 2399-8567 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB97/01176

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

3-6,8-11	as originally filed			
1,2,2a,7	as received on	03/07/1998	with letter of	25/06/1998

**Claims, No.:**

4 (part),5-15	as originally filed			
1-3,4 (part)	as received on	03/07/1998	with letter of	25/06/1998

**Drawings, sheets:**

1/5-5/5	as originally filed
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.  
☒ paid additional fees.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB97/01176

- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
- ☐ complied with.
- ☐ not complied with for the following reasons:
4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
- ☐ all parts.
- ☒ the parts relating to claims Nos. 1-8, 15.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	1-8, 15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-8, 15
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-8, 15
	No:	Claims	

2. Citations and explanations

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB97/01176

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**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**CONCERNING SECTION V**

1. The following documents have been cited:

D1 = WO 9 427 897 A

D2 = GB 2 251 975 A

D3 = GB 2 013 964 A

D4 = US 4 074 422 A

2. The closest prior art is represented by D1 = WO, A, 9 427 897 (see in particular pages 3 and 7 and figures 3, 6 and 9). The apparatus disclosed in D1 solves the technical problem of facilitating the loading of groups of battery plates into the cells of a battery box, a technical problem similar to the present invention. The prior art apparatus features guide means extending across the full width of the compartments in which the battery plates rest, compressed by the moveable walls and engaging into the battery cells, so as to guide the plates when they are dropped into the same.

However, in contrast thereto, in the present invention the groups of plates may be loaded *while still under compression* (see claim 1), ensuring that electrolyte in the separators of a battery is in active contact with the plates and that the groups do not snag on the box walls during loading. This improvement is neither taught nor suggested by D1 or other prior art documents.

The subject matter of Claim 3 differs from claim 1 in that the guide means are missing and *stop means* are present. The stop means serve to align the plates among themselves and to prevent downward movement and lateral movement. The problem of aligning the plates has been addressed by the prior art, see D4 = US, A, 4 074 422 (in particular col. 4 lines 6 - 9). D4 discloses, in an otherwise very similar frame, bottom plates lying beneath the electrode set to form a floor therefore. However, this prior art fails to disclose or suggest the removable stop means characterizing the battery loading frame as claimed in claim 3 of the present invention.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB97/01176

Claims 2 is directed at a frame combining the features of claim 1 and 3 (ie, featuring both the guide means and the stop means).

The subject matter of independent claim 15 is directed at an apparatus for unloading groups of batteries from a jig box and loading them into a battery box, combining the frame of claim 9 (equivalent to claim 3) with additional means of removing the stop means and with pushing means for the groups. While such pushing means are known from D1 and from D2 = GB, A, 2 251 975 (see Fig. 2), the removable stop means are, as already indicated, nowhere suggested.

3. The subject matter of claims 1 - 8, 15 is therefore novel and non-obvious, having regard to the cited prior art. The industrial applicability of the invention is self-evident.

The requirements of Article 33(2), (3) and (4) PCT are therefore met.

***REGARDING SECTION VII***

1. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
2. Clerical errors:

Page 1, line 7: microporous

Page 7, line 2: and

***REGARDING SECTION VIII***

The statement in the description on page 5, second paragraph, implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, PCT/GL/3 III, 4.3a).

Loading Apparatus

This invention relates to apparatus for loading battery plate groups into a battery box and, in particular, but not exclusively to loading groups for recombination batteries.

5        Recombination batteries (i.e. batteries in which the hydrogen and oxygen recombine to form water) tend to have separators of microporous glass fibre in which the acid electrolyte is fully absorbed. The separator material is extremely delicate and the group has to be loaded into the  
10    battery box in a compressed state (and retained in that state by the box) in order to ensure that the electrolyte is in active contact with the plates.

It will readily be appreciated that there are significant difficulties in inserting the compressed group  
15    into the battery box cell when that cell is substantially the same size without damaging the separators.

There are also problems in transferring such groups from the processing jig boxes, because the walls in the jig boxes which apply the compression can mark the separators if  
20    they do not act over the full separator surface. Accordingly attempts have been made to load the groups directly from the jig box by providing guides on the ends of the jig box walls. However, these guides can only extend partially across the width of the battery cell, because space must be  
25    allowed for the transverse supports on which the group elements sit when the jig box is being loaded. The result is that the unguided portions of the groups snag on the box wall.

From one aspect the invention consists in a frame for use in loading groups of battery plates into respective cells in a box, comprising a plurality of spaced walls defining respective group receiving spaces, the walls being  
5 moveable away from and towards each other to allow groups to be inserted in the spaces and subsequently grippingly retained therein and compressed by the walls, and guide means mounted at the lower end of the walls to locate in the cells and form a continuous surface with the walls  
10 characterised in that guide means extend across the full width of the walls, cells or groups, and in that the groups may be loaded from the frame whilst still under compression.

It is particularly preferred that the frame further comprises stop means for each space insertable between a  
15 respective pair of walls into the respective space to locate the bottom edge of a group when it is placed into the space.

From another aspect the invention consists in a frame for use in loading groups of battery plates into respective cells in a box, comprising a plurality of spaced walls  
20 defining respective group receiving spaces, the walls being moveable away from and towards each other to allow groups to be inserted into the spaces and subsequently grippingly retained therein by the walls characterised in that it further comprises removable stop means for each space  
25 insertable between a respective pair of walls into the respective space to locate the bottom edge of a group when it is placed into the space.

Conveniently, in either case, the stop means locates the group against downward movement and lateral movement

AMENDED SHEET

and is generally indicated 18. However the unloading station 18 has a number of new and inventive features. A jig box 19 is illustrated at the station and it can be seen that it defines a plurality of side-by-side spaces 20 in which the groups are contained. (The groups are not shown in Figure 3). When the jig box 19 arrives at the unloading station 18 the groups 12 are gripped within the spaces 20. Contrary to traditional jig boxes designed for automatic unloading, the walls 21 of the jig box 19 are continuous and extend over almost the full area of the engaged faces on the groups 12. This means that it is not possible to remove the groups from the jig box by the traditional method of passing gripping fingers through gaps in the wall to engage the groups. The Applicant has overcome this problem by providing a series of supports 22 which are initially raised to the position shown in Figure 3 at which they engage the lower most edge of the groups 12, as indicated by the broken line 23. (The supports 22 may have upstanding ends (not shown) to restrict lateral movement of the groups 12.)

Once the groups 12 are engaged by the supports 22, the walls 21 can be moved marginally away from each other to release the groups, whereupon further upward movement of the supports 22 allows the groups 12 to be pushed up through the spaces 20 so that they stand substantially proud of the jig box 18 as illustrated at 24 in Figure 4. In this position the groups 12 are engaged by plates 25 of gripper heads 26 and they can then be raised out of the jig boxes as illustrated at 27 in Figure 4.

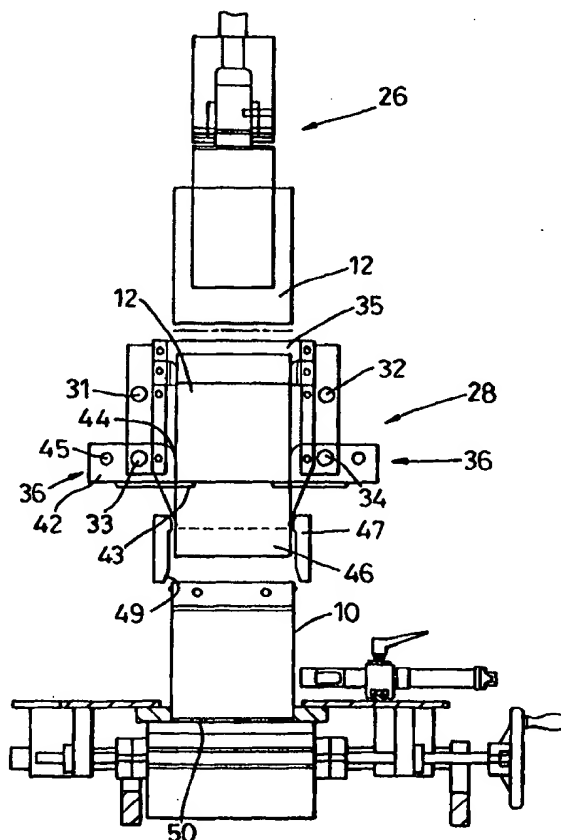


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>H01M 10/14, B65H 31/06, H01M 10/12, 10/04, 2/28, 2/26, B65H 31/24</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 97/44846</b>
<b>(21) International Application Number:</b> PCT/GB97/01176 <b>(22) International Filing Date:</b> 1 May 1997 (01.05.97) <b>(30) Priority Data:</b> 9610441.9 17 May 1996 (17.05.96) GB		<b>(43) International Publication Date:</b> 27 November 1997 (27.11.97)  <b>(81) Designated States:</b> AU, CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>
<b>(71) Applicant (for all designated States except US):</b> TBS ENGINEERING LIMITED [GB/GB]; Longhill, Elmstone Hardwicke, Cheltenham, Gloucestershire GL51 9TY (GB).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> <del>BARGE</del> , Christopher, Stephen [GB/GB]; 33 Weston Crescent, Horfield, Bristol BS7 8US (GB); <del>GARDINER</del> , Lawrence, Ernest [GB/GB]; Sheephouse, Painswick, Stroud, Gloucestershire GL6 6RX (GB).  <b>(74) Agents:</b> DUNLOP, Brian, Kenneth, Charles et al.; Wynne-Jones, Laine & James, 22 Rodney Road, Cheltenham, Gloucestershire GL50 1JJ (GB).		

**(54) Title:** FRAME AND LOADING APPARATUS FOR GROUPS OF BATTERY PLATES**(57) Abstract**

This invention relates to apparatus for loading battery plate groups into a battery box. The apparatus includes a compression frame (28) which includes a number of relative movable walls (35) and stops (36) for gripping and retaining battery groups. The wall (35) carry guide shins (46) for projecting into respective cells in a battery box (16) and guide the groups into the cells as they are pushed by a pusher (51). The movable nature of the walls (35) allow the groups to be loaded into frame (28), when it is in released position. The walls (35) can then be drawn together compressing the groups and retaining them in a compressed state as they are loaded.



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DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		



## FRAME AND LOADING APPARATUS FOR GROUPS OF BATTERY PLATES

This invention relates to apparatus for loading battery plate groups into a battery box and, in particular, but not exclusively to loading groups for recombination batteries.

5        Recombination batteries (i.e. batteries in which the hydrogen and oxygen recombine to form water) tend to have separators of microporous glass fibre in which the acid electrolyte is fully absorbed. The separator material is extremely delicate and the group has to be loaded into the  
10       battery box in a compressed state (and retained in that state by the box) in order to ensure that the electrolyte is in active contact with the plates.

It will readily be appreciated that there are significant difficulties in inserting the compressed group  
15       into the battery box cell when that cell is substantially the same size without damaging the separators.

There are also problems in transferring such groups from the processing jig boxes, because the walls in the jig boxes which apply the compression can mark the separators if  
20       they do not act over the full separator surface. Accordingly attempts have been made to load the groups directly from the jig box by providing guides on the ends of the jig box walls. However, these guides can only extend partially across the width of the battery cell, because space must be  
25       allowed for the transverse supports on which the group elements sit when the jig box is being loaded. The result is that the unguided portions of the groups snag on the box wall.

From one aspect the invention consists in a frame for use in loading groups of battery plates into respective cells in a box, comprising a plurality of spaced walls defining respective group receiving spaces, the walls being  
5 moveable away from and towards each other to allow groups to be inserted in the spaces and subsequently grippingly retained therein by the walls, and guide means mounted at the lower end of the walls to locate in the cells and form a continuous surface with the walls characterised in that  
10 guide means extend across the full width of the walls, cells or groups.

It is particularly preferred that the frame further comprises stop means for each space insertable between a respective pair of walls into the respective space to locate  
15 the bottom edge of a group when it is placed into the space.

From another aspect the invention consists in a frame for use in loading groups of battery plates into respective cells in a box, comprising a plurality of spaced walls defining respective group receiving spaces, the walls being  
20 moveable away from and towards each other to allow groups to be inserted into the spaces and subsequently grippingly retained therein by the walls characterised in that it further comprises stop means for each space insertable between a respective pair of walls into the respective space  
25 to locate the bottom edge of a group when it is placed into the space.

Conveniently, in either case, the stop means locates the group against downward movement and lateral movement

relative to the mid-plane of the group. In any of these cases, the stop means should be removable from the spaces. Thus, for example, the stop means may provide orthogonal abutments and may be rotatable about an axis adjacent to the intersection of the abutments so that the stop means can be  
5 rotated into and out of the space. The stop means may also be moveable with or in relation to the walls to maintain their relative location vis-à-vis the walls.

The distance between the group bottom edge location defined by the stop means and the top of its associated  
10 walls is preferably greater than the total height of the groups. This prevents any part of the group becoming snagged on the edges of the walls during insertion from the frame.

From yet another aspect the invention consists in  
15 battery group loading apparatus including a frame as defined above and further comprising means for loading groups into respective spaces in the frame to sit on the respective stop means, means for moving the walls towards each other to grip the groups between the walls, means for removing the stop  
20 means from the spaces, means for engaging a battery box with the guide means and means for pushing the groups through the guide means into the box.

Preferably the means for moving the walls towards each other are designed to exert compressive forces on the  
25 groups, in which case this force can be maintained during the operation of the pushing means.

The pushing means may act simultaneously on all the groups and may have heads, each of which may be formed with

formations to cooperate with the terminal posts or straps cast on the groups so as to achieve precise location between the head and the group.

From another aspect the invention includes apparatus  
5 for unloading a battery group from a jig box including support means for engaging the bottom of a group on a support, whilst the group is held in a jig box, means for releasing the groups within the jig box, means for raising the support to a level at which a substantial portion of a  
10 supported group would stand clear of the jig box and means for gripping the raised group. The support may include lateral abutments for preventing sideways movements of the group during raising.

From a further aspect the invention consists in  
15 apparatus for unloading groups with cast on straps from a jig box and for loading those groups into a battery box comprising the apparatus for unloading as defined above and the battery group loading apparatus as defined above.

From a still further aspect the invention consists in  
20 a method of unloading a battery group from a jig box including engaging the bottom of a group on a support, releasing the grip of the jig box on the group, raising the support and hence the group until a substantial portion of the group is clear of the jig box and gripping the raised  
25 group.

The advantage of this method and the associated apparatus defined above, is that, in contrast to existing gripping arrangements (where the groups are gripped through

openings in the jig box, whilst the groups are still in the box) is that both the jig box and the gripping means may be provided with gripping surfaces which are continuous over the whole portion which engages the group. This prevents  
5 damage and marking of the outside separators.

Although the invention has been defined above, it is to be understood that it includes any inventive combination of the features set out above or in the following description.

The invention may be performed in various ways and a  
10 specific embodiment will now be described, by way of example, with the reference to the accompanying drawings, in which:

Figure 1 is a view from above of a recombination battery with its lid removed;

15 Figure 2 is a vertical section through an end cell of Figure 1 showing the group in situ;

Figure 3 is a part schematic view of an unloading station of a machine for casting straps on battery groups;

Figure 4 is a diagrammatic representation of the  
20 removal of groups from the jig box of the machine of Figure 3;

Figure 5 is a diagrammatic representation of a loading configuration and illustrates in descending order a gripper holding groups, a compression frame and a battery box on a  
25 conveyor;

Figure 6 is a view from above on the compression frame of Figure 5;

Figure 7 is a schematic partial side view of part of

the frame of Figure 6; and

Figure 8 is a edge view of a stuffing tool for pushing the groups from the frame of Figure 7 into a battery box.

As has been mentioned previously recombination  
5 batteries require that the battery groups of plates and separators are inserted into the cells of a battery box under compression and that that compression is maintained by the walls of the battery box cells.

Figure 1 illustrates a battery box 10 have cells 11 in  
10 which groups 12 have been inserted. The groups 12 comprise interleaved separators 13 and plates 14. The plates 14 have lugs 15 onto which straps 16 or terminal posts 17 have been cast by a machine for casting on such straps.

Whilst such machines can take a number of forms, they  
15 now typically comprise a rotatable table which can support jig boxes in a series of circumferentially spaced locations. Each jig box comprises a number of spaces or cells into which groups can be loaded at a loading station and the jig boxes have walls which can be moved towards and away from  
20 each other to group and release the groups. As the table indexed around the groups pass through stations in which they are aligned, the lugs cleaned and fluxed, and have straps and terminal posts cast on them so that by the time  
25 a jig box arrives at an unloading station it contains, in the correct order and alignment, a set of groups 12 ready for loading into a battery box. The Applicants sell examples of such machines under the Trade Marks COS5 and COS8.

Such an unloading station is illustrated in Figure 3

and is generally indicated 18. However the unloading station 18 has a number of new an inventive features. A jig box 19 is illustrated at the station and it can be seen that it defines a plurality of side-by-side spaces 20 in which the groups are contained. (The groups are not shown in Figure 3). When the jig box 19 arrives at the unloading station 18 the groups 12 are gripped within the spaces 20. Contrary to traditional jig boxes designed for automatic unloading, the walls 21 of the jig box 19 are continuous and extend over almost the full area of the engaged faces on the groups 12. This means that it is not possible to remove the groups from the jig box by the traditional method of passing gripping fingers through gaps in the wall to engage the groups. The Applicant has overcome this problem by providing a series of supports 22 which are initially raised to the position shown in Figure 3 at which they engage the lower most edge of the groups 12, as indicated by the broken line 23. (The supports 22 may have upstanding ends (not shown) to restrict lateral movement of the groups 12.)

Once the groups 12 are engaged by the supports 22, the walls 21 can be moved marginally away from each other to release the groups, whereupon further upward movement of the supports 22 allows the groups 12 to be pushed up through the spaces 20 so that they stand substantially proud of the jig box 18 as illustrated at 24 in Figure 4. In this position the groups 12 are engaged by plates 25 of gripper heads 26 and they can then be raised out of the jig boxes as illustrated at 27 in Figure 4.

The removed groups 12 can then be transported laterally by the heads 26 until they overlies a compression frame, which is generally indicated at 28, as can be seen in Figure 5. The compression frame 28 is more fully illustrated in Figures 6 and 7 and includes two end pieces 29, 30, which are interconnected, at each side, by pairs of vertically spaced horizontal rods 31-34. Walls 35 are slidably mounted on the upper rods 31-32, whilst stops 36 are rotatably and slidably mounted on the lower rods 33-34; there being a pair of opposed stops 36 for each group space 37 defined between a pair of adjacent walls 35. The walls 35 and stops 36 are interlinked by respective chains 38, 39 so that when an end stop and wall combination 40 is pulled away from its adjacent wall, the other walls and stops are pulled apart equally to spacing defined by the lengths of the chains. This movement is obtained by cylinder 60, which can also move in the opposite direction to compress the walls 35 together to spacings defined by spacers 41. These two positions constitute the open and closed positions of the frame 28.

As can be seen in Figure 5 each stop 36 comprises a generally rectangular body 42, which is slidably and rotatably mounted on a respective rod 33, 34, and a projecting foot 43 for supporting the bottom of a group 12. The inward ends 44 of the bodies 42 define lateral abutments for the groups 12 so that they cannot move in a sideways direction. The bodies 42 on each side are interlinked as a set by respective rods 45, which can be used to rotate the



stops 36 from their support position, which is shown in Figure 5 to a generally vertical position in which they completely disengage the groups 12.

Each wall 35 carries one or more guide shims, which are  
5 designed to project into associated cells 11 of the battery box so that they define a guide surface for the groups to be slid along as they move into the respective cells 11. The shims 46 are formed continuously with their associated walls 35 so that there are no edges or projections which can  
10 damage the groups. Preferably the walls 35 and their shims 46 are formed from a single piece of highly polished flexible metal. The height of the walls from the location defined by the feet 43 is greater than the height of the groups, so that, once inserted, the groups cannot catch on  
15 any part of the wall and the width of the walls is greater than the width of the groups.

At the lower end of the frame 28 is mounted a rectangular guide frame 47, which receives and locates the frame 28 relative to a battery box 10 carried on a conveyor  
20 49. The guide frame 47 has a tapered open mouth 49 so that the box 10 is not damaged, when the frame 47 is engaged on it and equally the groups do not snag on the box 10 during insertion.

Returning to Figure 5, the groups 12 held in the  
25 gripping heads 26 are loaded into respective spaces between pair of walls 35, when the walls are in their "open" position. In this position the stops are arranged as shown in Figure 5 and so the groups are supported within their

respective spaces by pairs of feet 43 and are laterally located by ends 44. The walls 35 are then drawn together by cylinder 60 until they both grip and compress the groups 12. (Adjustable stops 40a define the limit of compression and may be provided in addition to or instead of stops 41. Their advantage is that they allow easy adjustment for different battery size. Stops 41 are in any case used for 'dry' running the machine.) The frame 28 is then lowered downwardly onto a battery box 10 which has been brought to the correct position by a conveyor 50 and the exact relative position between the battery box 10 and the frame 28 is defined by the guide frame 47. At this time the stops 36 can be swung out so that the groups can then be pushed downwardly, whilst still under compression into the cells 11. Because the walls 35 and shims 46 provide a continuous surface this is achieved simply, swiftly and without damage.

This pushing steps is achieved by a pusher (or stuffer) which is generally indicated at 51 in Figure 8. The pusher comprises a number of laterally spaced vertically dependent rods 52 each of which carries a head 53 at its free end. The upper ends of the rods 52 are located on a plate 54, which can be raised and lowered by a cylinder 55. The heads 53 are profiled so that they precisely receive the upper surface of the group, the exact shape being determined by whether the engaged group includes end terminals or simply straps. This profiling not only protects the group, but ensures very precise alignment between the heads 53 and the groups 12. Once the heads 53 have been engaged on the tops of the

groups 12, the cylinder 55 moves the pusher 51 downwards and the groups are pushed straight into the cells 11.

It will be understood that the whole arrangement of the frame 28 and the pusher 51 enables very precise relative  
5 location of the pusher 51, the groups 12 and the battery box 10 and so the insertion happens extremely smoothly, despite the very tight fit which is necessary in a recombination battery.

Although the invention has been described very much in  
10 the context of recombination batteries, the ability to load a series of adjacent cells simultaneously, is also attractive in the manufacture of other types of battery and the general principles outlined in the above specification may be equally applicable.

15 The precise construction shown in the drawings is advantageous, but the invention incorporates many variations. For example the stops could be slid in and out of the spaces, in which case a pair of stops could be constituted by a single element. Equally a single stop  
20 element might be swung up from one side.

Claims

1. A frame for use in loading groups of battery plates into respective cells in a box, comprising a plurality of spaced walls defining respective group receiving spaces, the walls being moveable away from and towards each other to allow groups to be inserted in the spaces and subsequently grippingly retained therein by the walls, and guide means mounted at the lower end of the walls to locate in the cells and form a continuous surface with the walls characterised in that guide means extend across the full width of the walls, cells or groups.

2. A frame as claimed in claim 1 further comprising stop means for each space insertable between a respective pair of walls into the respective space to locate the bottom edge of a group when it is placed into the space.

3. A frame for use in loading battery plates into respective cells in a box, comprising a plurality of spaced walls defining group receiving spaces, the walls being movable away from and towards each other to allow groups to be inserted into the spaces and subsequently grippingly retained therein by the walls characterised in that it further comprises stop means for each space insertable between a respective pair of walls into the respective space to locate the bottom edge of a group when it is placed into the space.

4. A frame as claimed in claim 2 or claim 3 wherein the stop means locate the group against downward movement and

lateral movement relative to the mid-plane of the group.

5. A frame as claimed in any one of claims 2 to 4 wherein the stops means are removable from the spaces.

6. A frame as claimed in any one of claims 2 to 5 wherein the stop means provide orthogonal abutments and are rotatable about an axis adjacent to the intersection of the abutments.

7. A frame as claimed in any one of claims 2 to 6 wherein the stops means are moveable with or in relation to the walls.

8. A frame as claimed in any one of the preceding claims wherein the distance between the group bottom edge location defined by the stop means and the top of its associated walls is greater than the total height of the groups.

9. Battery group loading apparatus including a frame as claimed in any one of claims 2 to 8 and further comprising means for loading the groups into respective spaces in the frame to sit on the respective stop means, means for moving the walls towards each other to grip the groups between the walls, means for removing the stop means from the spaces, means for engaging a battery box with the guide means and means for pushing the groups through the guide means into the box.

10. Apparatus as claimed in claim 9 wherein the means for moving the walls towards each other are further for exerting compressive forces on the groups.

11. Apparatus as claimed in claim 9 or 10 wherein the

pushing means acts simultaneously on all the groups.

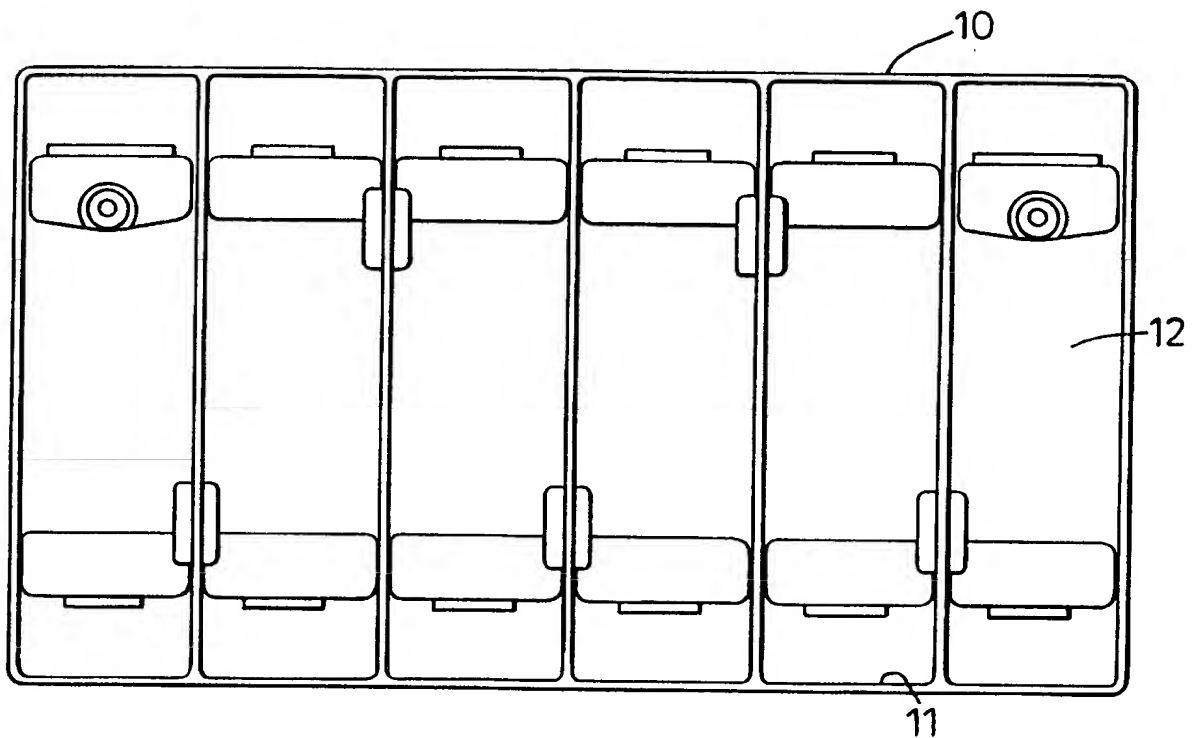
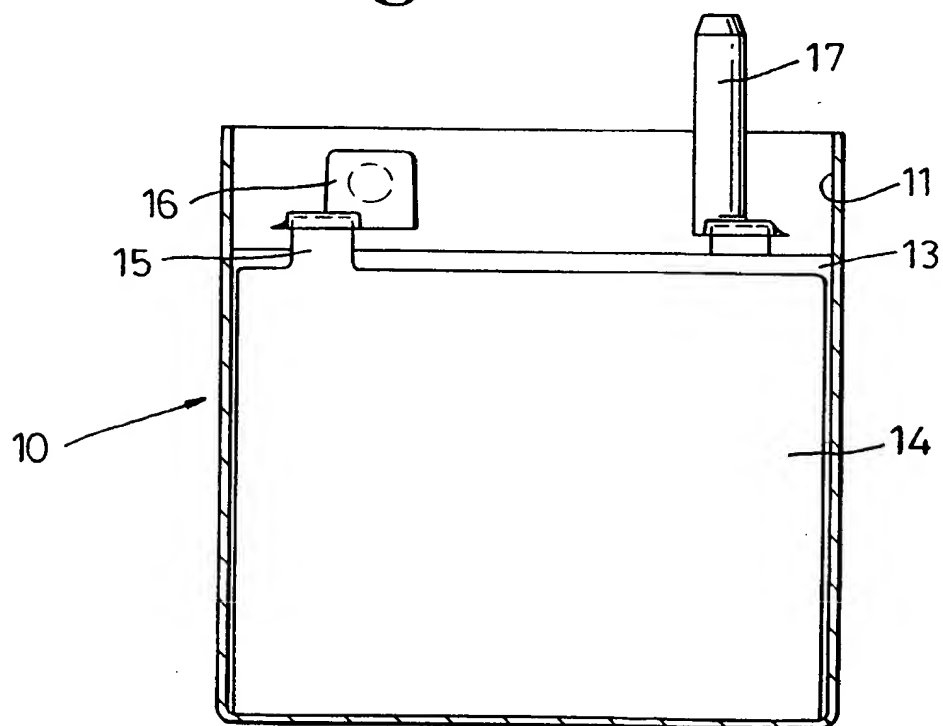
12. A method of unloading a battery group from a jig box including engaging the bottom of group on a support, releasing the grip of the jig box on the groups, raising the support and hence the group until a substantial portion of the group is clear of the jig box and gripping the raised group.

13. Apparatus for unloading a battery group from a jig box including support means for engaging the bottom of a group on a support, whilst the group is held in a jig box, means for releasing the groups within the jig box, means for raising the support to a level at which a substantial of a supported group would stand clear of the jig box and means for gripping the raised groups.

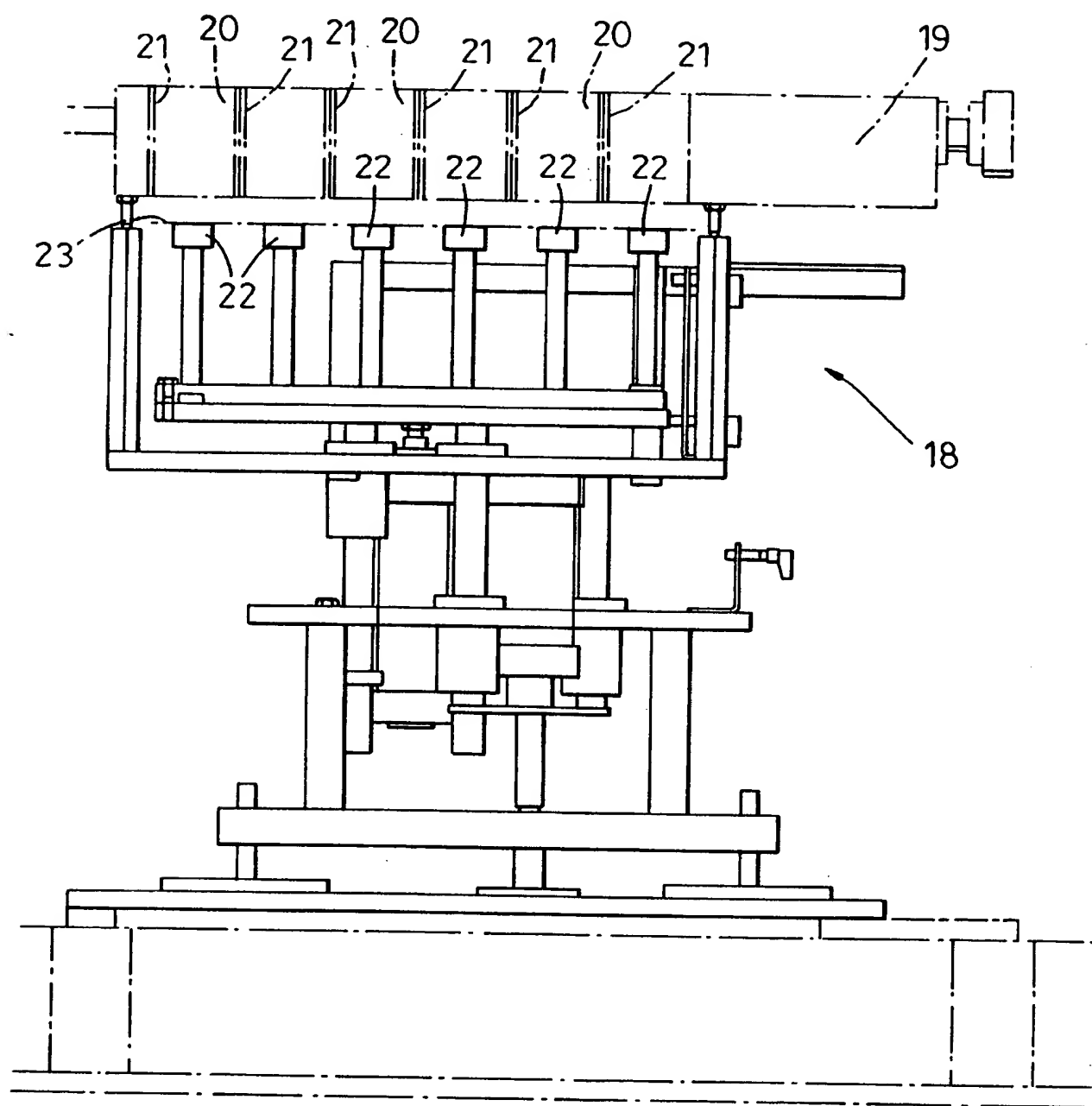
14. Apparatus as claimed in claim 13 wherein the support includes lateral abutments for preventing sideways movements of the groups during raising.

15. Apparatus for unloading groups with cast-on-straps from a jig box and for loading those groups into a battery box including apparatus for unloading as claimed in claim 13 or claim 14 and battery group loading apparatus as claimed in any one of claims 9 to 12.

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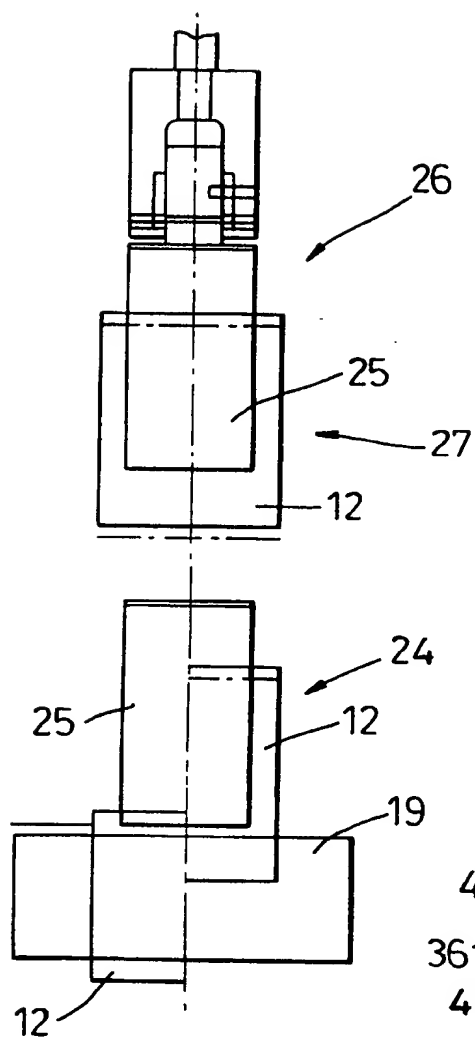
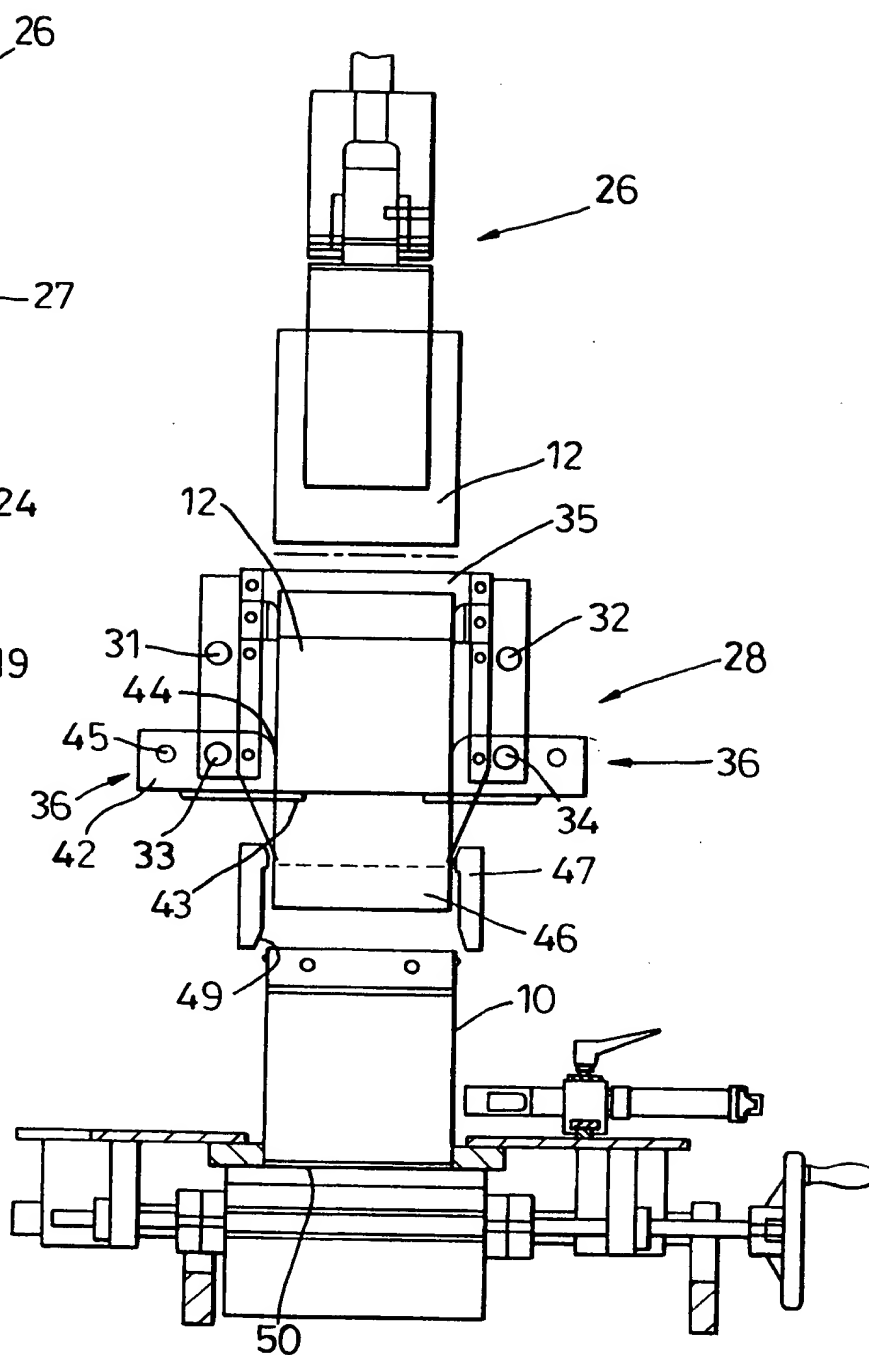
*Fig. 1**Fig. 2*

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*Fig. 3*



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**Fig. 4****Fig. 5**

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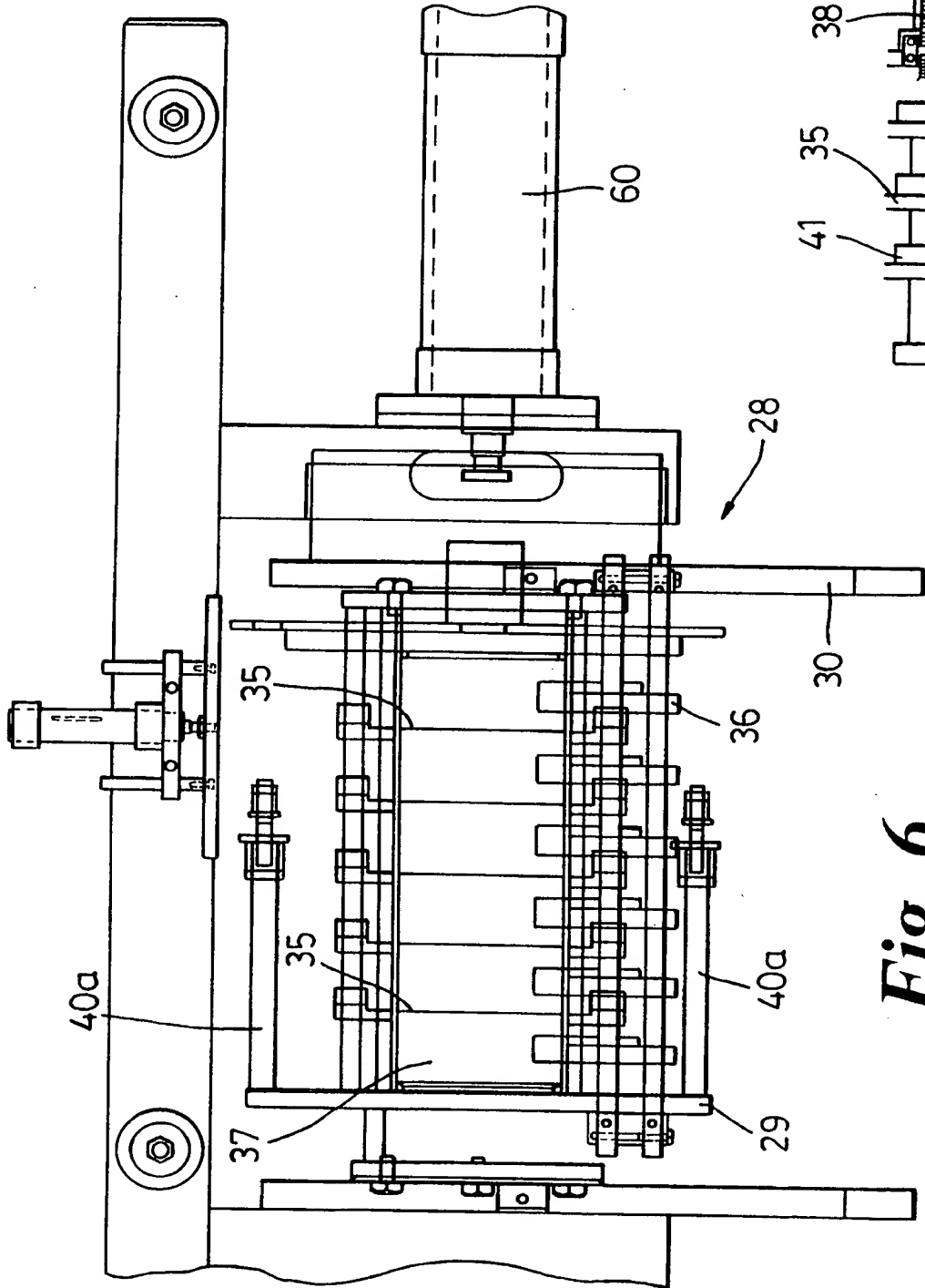


Fig. 6

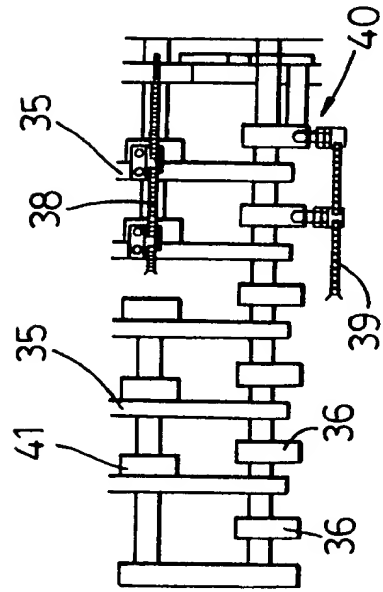
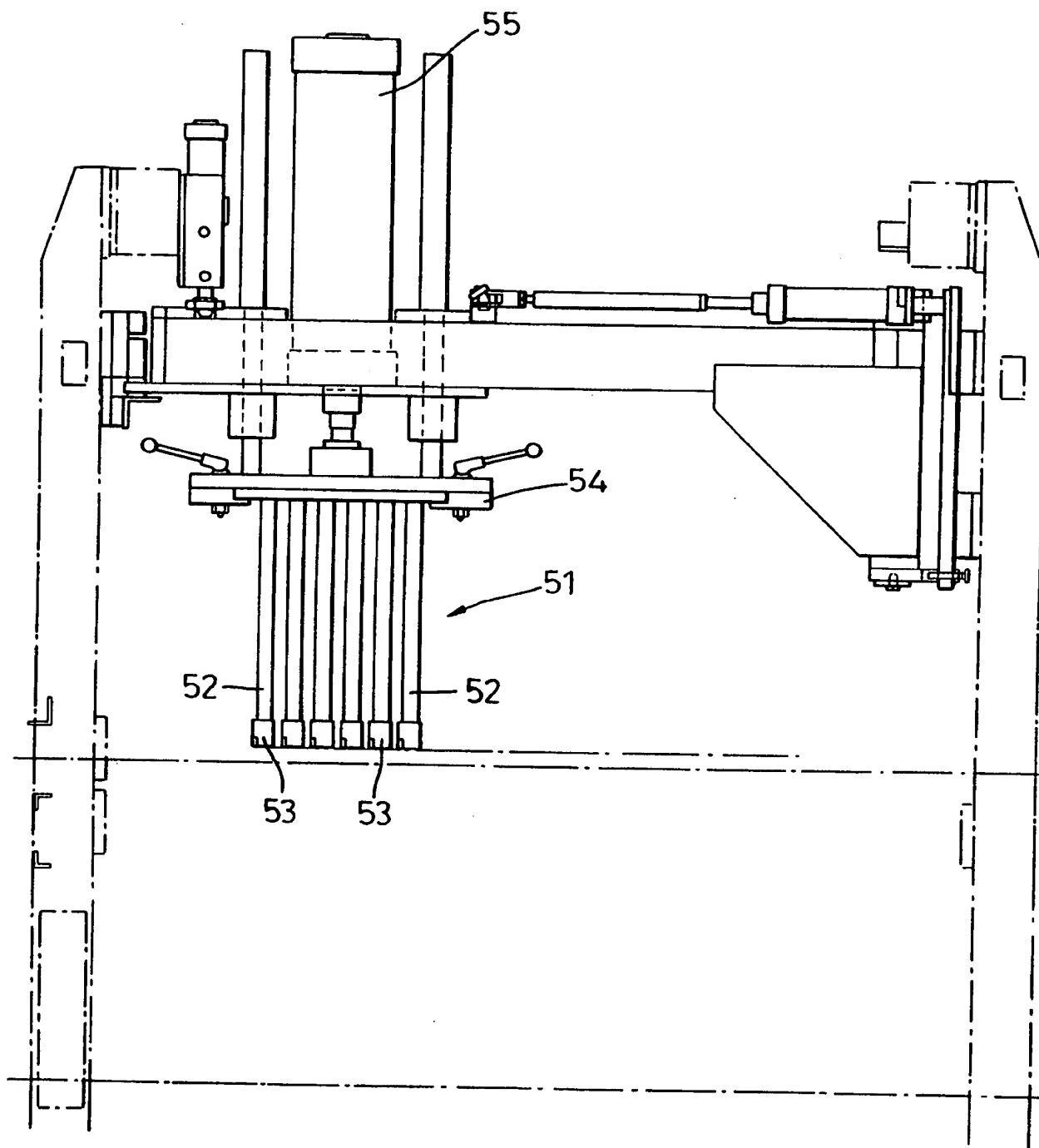


Fig. 7

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*Fig. 8*

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 97/01176

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01M10/14 B65H31/06 H01M10/12 H01M10/04 H01M2/28  
H01M2/26 B65H31/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01M B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94 27897 A (TBS ENG LTD ;HOPWOOD ROBERT TIMOTHY (GB)) 8 December 1994	1
Y	see page 3, line 1-28 see page 7, line 6-26 see figures 2,6,9	2-11
Y	GB 2 251 975 A (DAGA S R L) 22 July 1992 see figure 2 see page 3, line 4-17 see page 4, line 6-29 see page 6, line 17-30	1-11
Y	US 4 074 422 A (BORJESSON ANDERS ET AL) 21 February 1978 see column 2, line 17-54 see column 3, line 52 - column 4, line 9 see claims 1,7,8 see figures 1-7	1-11
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

24 July 1997

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International Application No  
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